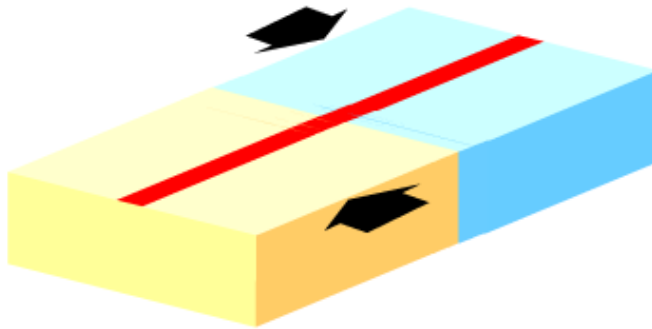
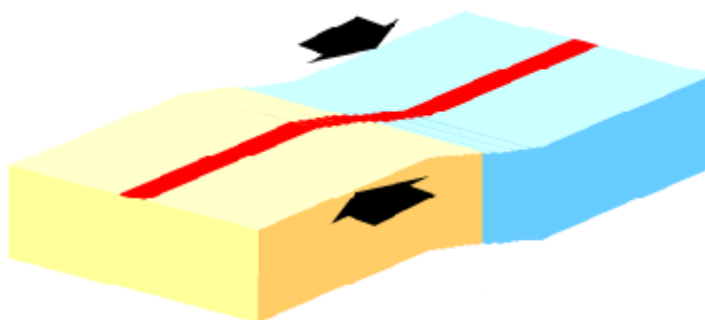


Why do earthquakes occur?



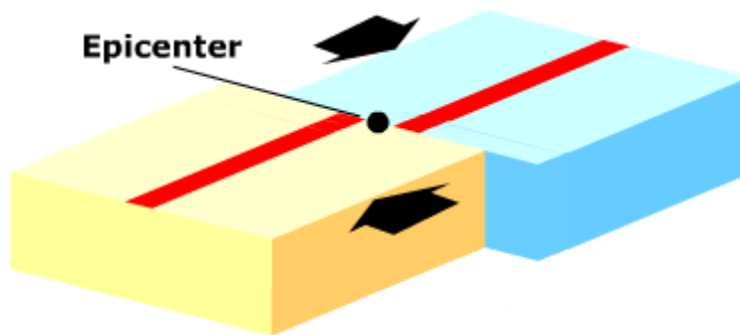
Most earthquakes occur along plate boundaries. The map on the right shows the probably best-known plate boundary on the Earth - the San Andreas Fault, which is the boundary between the Pacific plate and the North American plate. The Pacific plate moves toward northwest with a

velocity of about 5.5 cm per year relative to the North American plate. The two plates move with a constant velocity relative to each other. However, the motion along the fault does not occur with a constant velocity, as you will see on the next pages.



Enormous frictional forces are working along the boundary between the two lithosphere plates. The friction prevents slip along the boundary, and the crust is elastically deformed. Strain builds up in the rocks along the boundary as the two plates move

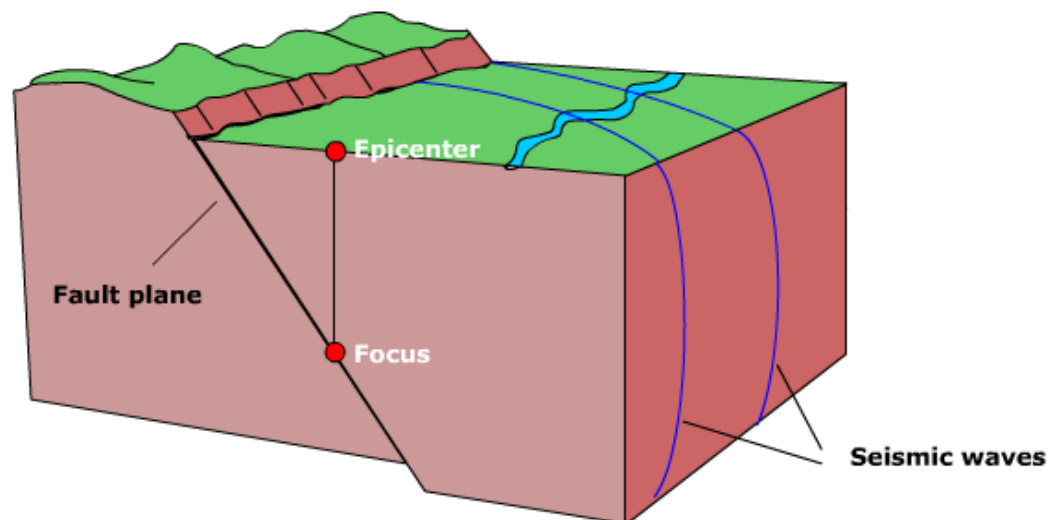
relative to each other. The build-up of strain can go on for several decades. As long as the frictional forces are able to prevent slip, no earthquake occurs in the area.



However, at some stage the elastic strain breaks the "frictional lock". When this happens, the two blocks of rock on both sides of the fault slip suddenly. If the "frictional lock" has been active for

tens of years, the sudden movement along the fault can be of several meters. The sudden movement sets off ground vibrations - an **earthquake**.

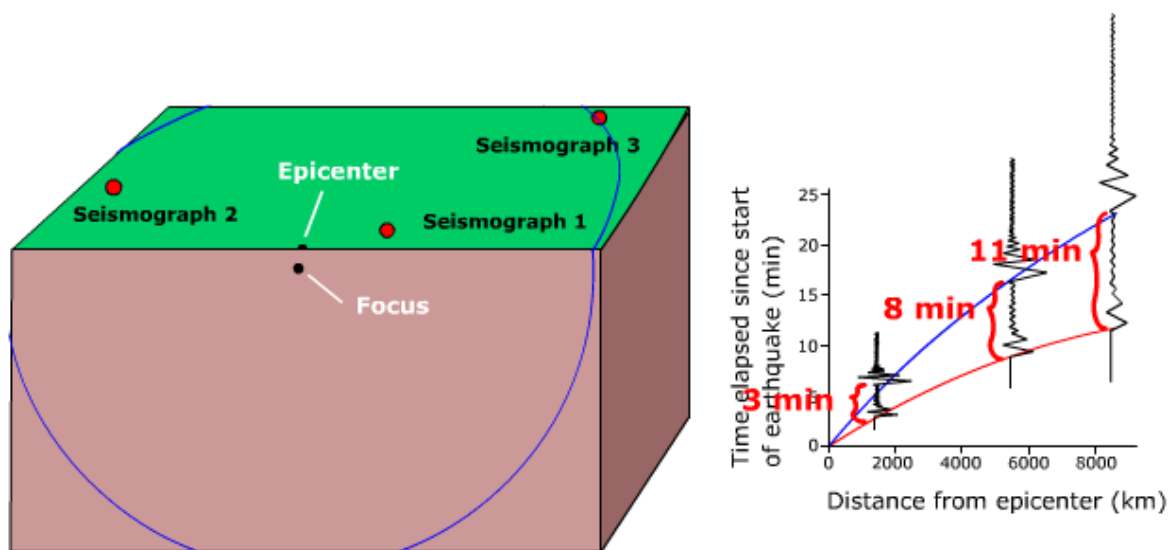
Focus and epicenter



When a fault is formed, the slip between the two blocks of the crust is initiated in a point. This point is called the **focus** of the earthquake. The **epicenter** is the point at the surface directly above the focus. Large amounts of energy may be released during the formation of a fault. The

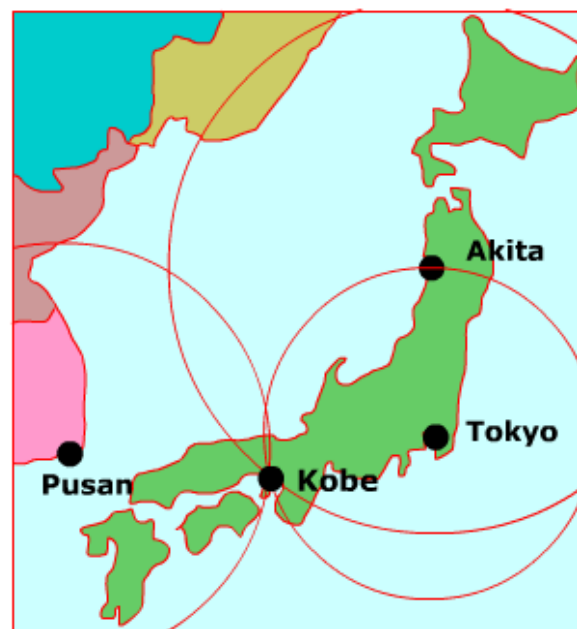
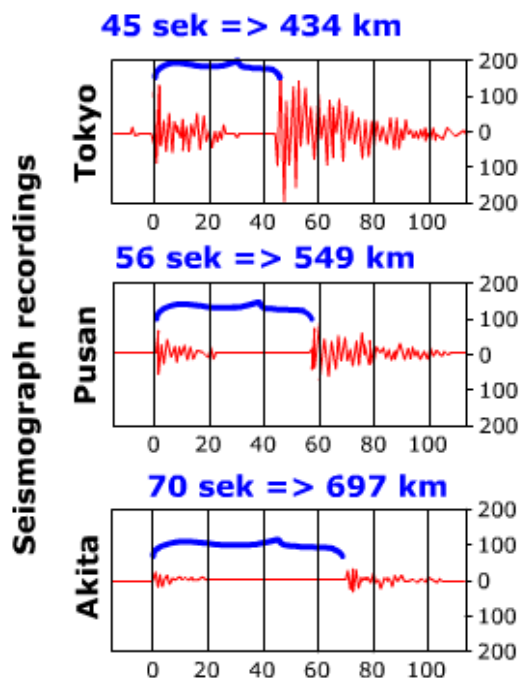
energy is transmitted in all directions away from the focus as **seismic waves**. Seismic waves travel outward from the focus of an earthquake much as waves on the surface of a pond travel away from the spot where a stone is dropped. However, seismic waves travel in three dimensions.

Distance between epicenter and seismograph



At seismograph 2, the time interval between the arrival of the first P waves and the first S waves is 8 minutes, corresponding to a distance from the

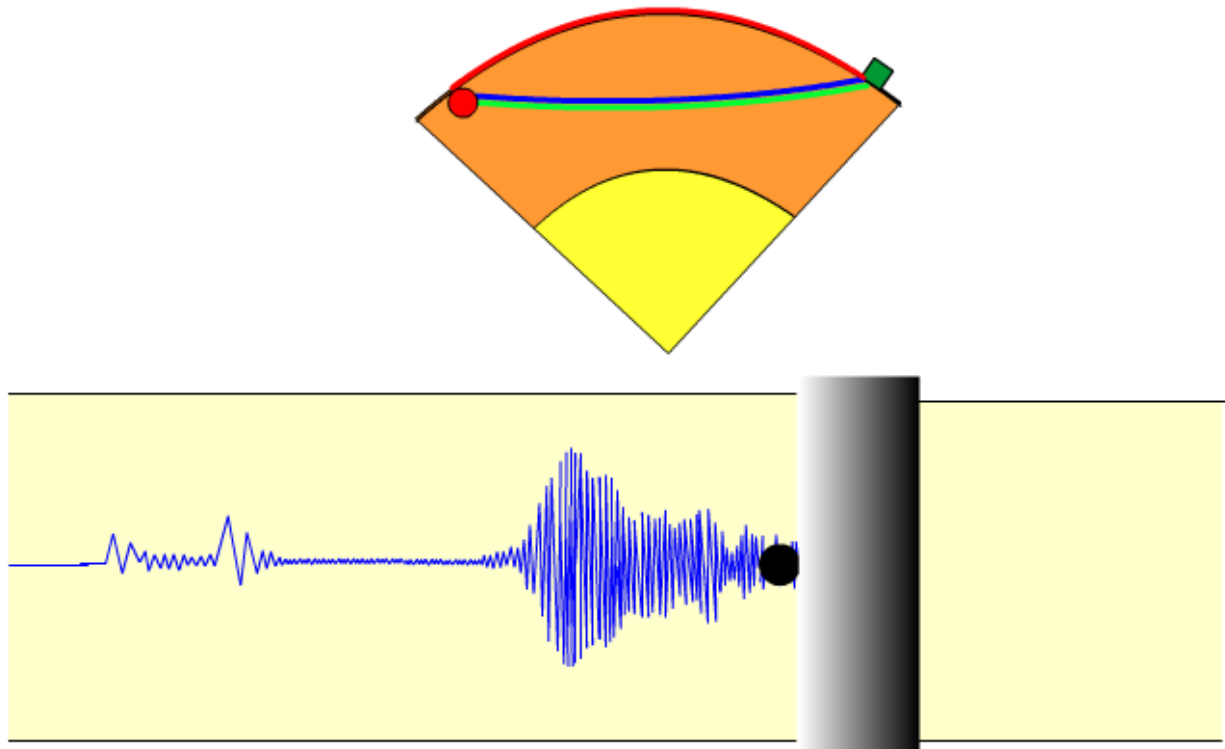
epicenter of about 5 500 km. At seismograph 3 the time interval of 11 minutes corresponds to a distance of nearly 9 000 km from the epicenter.



The seismogram that was recorded in Tokyo gives the concluding evidence. The three circles intersect

in one single point - the earthquake occurred close to Kobe.

Seismogram



Finally, the surface waves arrive. The surface waves cause the largest ground motions.

Summary

- When two lithosphere plates move relative to each other, strain is building up along the fault plane between the plates, because of the friction along the plane. When the strain breaks the "frictional lock" an earthquake is set off.
- When a fault is formed, the slip between the two blocks of the crust is initiated in a point. This point is called the focus of the earthquake. The epicenter is the point at the surface directly above the focus.
- The energy that is released during an earthquake is transmitted in all directions away from the focus as seismic waves: P waves, S waves and surface waves.
- Most earthquakes occur along plate boundaries. Along mid-ocean ridges and transform faults only shallow earthquakes occur, i.e. earthquakes with foci less than 100 km deep. In association with subduction zones, however, earthquakes with foci as deep as 800 km may occur.
- Every year, earthquakes cause large destructions around the world. Therefore, much research has focused on finding methods to predict earthquakes. Today, it is possible to characterize the degree of risk in a region. However, it is not possible to predict earthquakes consistently with the degree of accuracy that is needed to alert the inhabitants of a region within hours or days before the region is hit by an earthquake.

Useful expressions to explain earthquakes

- Elastic deformation
- Strain builds up
- Frictional forces prevent slip
- Strain breaks frictional lock
- Blocks of rock on both sides of the fault
- Sudden slip
- Slip initiates at the focus
- Energy transmitted away from the focus as seismic waves
- Seismographs record seismic waves arrival
- The time interval between the arrival of the first P-wave and the first S-wave

BY USING THE VOCABULARY ABOVE, EXPLAIN HOW AN EARTHQUAKE IS PRODUCED AND HOW GEOLOGISTS CAN LOCATE ITS FOCUS